ARS-BLM COOPERATIVE STUDIES
REYNOLDS CREEK WATERSHED

INTERIM REPORT No. 1

For Period July 1, 1968, to December 31, 1969

To

Portland Service Center

Bureau of Land Management

Portland, Oregon

FOR OFFICIAL USE ONLY

From the Northwest Watershed Research Center
Soil and Water Conservation Research Division
Agricultural Research Service
Boise, Idaho

MARCH 1970

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INTRODUCTION

Cooperative research was initiated between the USDA-ARS-SWC Northwest Watershed Research Center and the Bureau of Land Management Portland Service Center in July 1968 under Contract No. 14-11-001-4162 (N). The purpose of this endeavor is to accelerate research on precipitation-runoff and sedimentation characteristics of watershed areas with specific soil-vegetation characteristics, together with quantifying the effects of certain management and treatment practices applied thereto.

Representatives of the ARS and BLM met on several occasions during the summer of 1968 and in early 1969 to select study areas; to inspect field sites for possible treatment; and to establish procedures for making ground cover measurements.

STUDY SITES

The location of study sites selected on which investigations were instituted are shown in Figure 1.[1/] Guidelines for selection

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1/ Figures are grouped at end of report.

of study areas and procedures for evaluation of cover production, herbage yield, and soil conditions for different levels of management are presented in Research Outline 105.4 of the 1968 Annual Report, Appendix I, and in the 1969 Annual Report, Appendix II. Tabulated information of the study sites--including data on size, condition, elevation, geologic material, cover, and annual precipitation--is shown in Table I.

Photographs for most of the study sites and a topographic map of the Upper Sheep Creek site are included as figures in the following order:

Figure 2. View of Summit Basin and Weir.

Figure 3. Study Site on Sediments.

Figure 4. Study Site on Nancy's Draw with fenced area in distant background.

Figure 5. Lower Sheep Creek Study Basin with Weir in distant background.

Figure 6. Topographic Map of the Upper Sheep Creek Study Basin showing locations of weirs and other instrumentation.

Figure 7. Upper Sheep Creek Study Basin showing fenced area in foreground and fenced-treated plots on snow-covered slope (northern slope).

TABLE 1. --Tabulated information on study sites.

Location Name and Number	Condition	Area (Acres)	Elevation Range (Feet)	Geologic Materials	Percent Cover Brush	Grass	Rock	Annual Precipitation 3/ (Inches)
Summit Basin 048077	Grazed	205	4140-4800	Granite Basalt	9	15	15	9 (10)
Sediments 067005	Grazed	2	3900	Sediments	18	7	0	8 (9)
	Fenced	1	3900	Sediments	22	7	0	
Nancy Draw 098098	Grazed	3	4635-4700	Basalt	20	11	4	12 (14)
	Fenced	2	4610-4640	Basalt	20	4	4	
Lower Sheep Creek Basin 117066	Grazed	28	5208-5443	Rhyolite	15	7	15	13 (16)
	Fenced	4	5350-5435	Rhyolite	14	8	5	
Upper Sheep Creek Basin 138021 (South Slope)	Fenced	.3	6075-6170	Basalt	39	32	0	17 (22)
	Brush 1/ Sprayed	.3	6085-6180	Basalt	35	30	0	
	Brush Removed	.3	6095-6185	Basalt	0 2/	35	0	
	Grazed	24	6030-6565	Basalt	--	--		

1/ Brush sprayed with 2-4-5T on July 8, 1969.

2/ After Brush removal on July 5-6, 1969.

3/ Precipitation as measured by unshielded gages with computed precipitation in parenthesis.

TABLE 1. --Tabulated Information on study sites (Continued)

Location Name and Number	Condition	Area (Acres)	Elevation Range (Feet)	Geologic Materials	Percent Cover			Annual Precipitation 3/ (Inches)
					Brush	Grass	Rock	
Upper Sheep Creek 138021 (North Slope)	Grazed	21	6030-6505	Basalt	--		--	17 (22)
	Fenced	1.5	6065-6155	Basalt	12	3	7	
Reynolds Mtn. East Basin 166076	Grazed	100	6620-7025	Basalt) Rhyolite Latite) Mixed	32	17	9	23 (32)

INSTRUMENTATION

Two runoff and sediment-measuring stations were essentially completed and put into operation at the lower and upper sites in the Upper Sheep Creek Study Basins, Figures 6, 8, and 9.

In the fall of 1969, the north-facing slope of the Upper Sheep Creek Study Basin, Figure 6, was instrumented for an initial check on a numerical solution of the steady-state two-dimensional flow system, resulting from infiltration on a watershed. Two piezometers were installed and cemented in with perforation properly located for measurement of the potential surface of the saturated zone in the fractured layer--8-14 feet below the surface--located above the impermeable bedrock. In addition, five access tubes were installed for obtaining neutron soil moisture measurements and two dual gamma probe access tube sites were installed for measurement of soil density (moisture) and for use in infiltration investigations with a gamma probe-rainfall simulator infiltrometer.

Holes for soil moisture access tubes and piezometers were drilled with a hydraulically-operated rotary drill rig, Figure 10. For operation on steep slopes, the drill rig was supported on special cable lifted platform attached to a D-7 caterpillar tractor in place of the blade. Measurement of soil moisture by use of the neutron

probe in the Lower Sheep Creek study basin under winter conditions is shown in Figure 11.

A previously installed climatological station in the Sheep Creek drainage, including two hydraulic weighing lysimeters, is shown in Figure 12. Two other similar climatological stations in the Reynolds Creek Watershed are located in sections numbered 76 and 176 in Figure 1.

A micrometeorological tower and a three-directional wind system for independent determination of evapotranspiration is shown in Figure 13. This measuring system for energy budget determination was furnished by the University of Idaho, Forestry Department, and operated by Dr. George Belt as a cooperative endeavor.

Infiltration studies will be undertaken by employing a special gamma probe-rainfall simulator infiltrometer, as shown in Figure 14, which has been built by Mr. Vance Penton under a cooperative agreement with the Engineering Experiment Station, University of Idaho.

The sediment and runoff measuring station for the Reynolds Mountain East Basin is shown in Figure 15. The upstream sediment box is used to measure bedload as for the Upper Sheep Creek Measuring Stations, Figures 8 and 9. A Chickasha suspended sediment pumping sampler, Figure 16, is installed in the heated weir shelter, Figure 15. Similar pump samplers will be installed at the other weir sites.

INVESTIGATIONS

The approach for obtaining quantitative information on runoff and sediment yields from rangelands with an assessment of the effects of land management or treatment is based on the application of model studies to establish the governing relationships for the components of the water balance. Surface runoff is viewed as the residual from an infiltration model. Subsurface flows are in turn treated as unsaturated flow in the zone above the water table with ground-water flow models applied to the aquifers.

Modelling of the infiltration process, including percolation, will be considered in two phases. First, the initial retention will include the extraction of water to satisfy interception, surface depression, and the topsoil macro-pore space. The site potential of this initial retention would be considered as independent of rainfall intensity and soil physical properties, including antecedent soil moisture.

In the second phase, infiltration would be governed by the soil physical properties and the antecedent soil moisture. It is expected that the level of management or treatment of uncultivated rangelands would significantly alter the potential for initial retention of precipitation.

Soil physical properties would be more conservative but any practice or treatment that influenced evapotranspiration would directly affect the level of infiltration by altering the soil moisture levels.

Evapotranspiration would be markedly influenced by the vegetative cover and the plant species. The induced surface roughness and differences in albedos and net radiation could effect the energy balance and alter the evapotranspiration. Indeed, any increase in rooting depth or root proliferation would increase evapotranspiration since available soil moisture is the controlling factor. Alteration in vegetative cover and mass would also influence the potential for initial retention.

Properly constructed infiltration and evapotranspiration models, developed from laboratory and field data, offer an inviting method for predicting the water balance of rangelands with water yield as a highly important residual. The seasonal soil moisture status, however, is equally important from the management standpoint.

The ability to predict the surface runoff component is a basic requirement in sediment yield estimates.

Investigations concerning sediment yield are based upon a model concept of relating soil movement to rainfall, runoff and associated site hydraulic parameters. The site erosion or sediment yield potential would be related to soil physical properties, cover, and land-use factors.

Progress toward the development of models for predicting the water balance, and water and sediment yields of rangelands is briefly outlined under the following topics dealing with infiltration, evapotranspiration, and sediment yield.

Infiltration

Initial investigations into the watershed infiltration problem was done as a cooperative study with the Utah State University. A formal report: "Theoretical and Experimental Aspects of Watershed Infiltration in Terms of Basic Soil Properties," by R. William Nelson and Roland W. Jeppson, has been prepared. A copy of this report is submitted as Appendix III. This cooperative work has produced a second report: "Numerical Solution of the Steady-State Two-Dimensional Flow System Resulting from Infiltration on a Watershed," by Roland W. Jeppson. A copy of this report is submitted as Appendix IV.

The development of instrumentation to conduct field infiltration studies has been pursued cooperatively with the University of Idaho. A gamma probe-rainfall simulation infiltrometer has been constructed and tested, Figure 14. Collection of field data is scheduled for the spring and summer of 1970.

Summaries of the studies dealing with infiltration are reported in the Annual Reports for 1968 and 1969 (Appendices I and II). Research Outlines 105.3, 105.5, and 105.6 cover this work.

Evapotranspiration

Studies of natural evapotranspiration from sagebrush rangelands were initiated in 1968. Four hydraulic weighing lysimeters, two each at the Sheep Creek and Reynolds Mountain Weather Stations, are in operation.

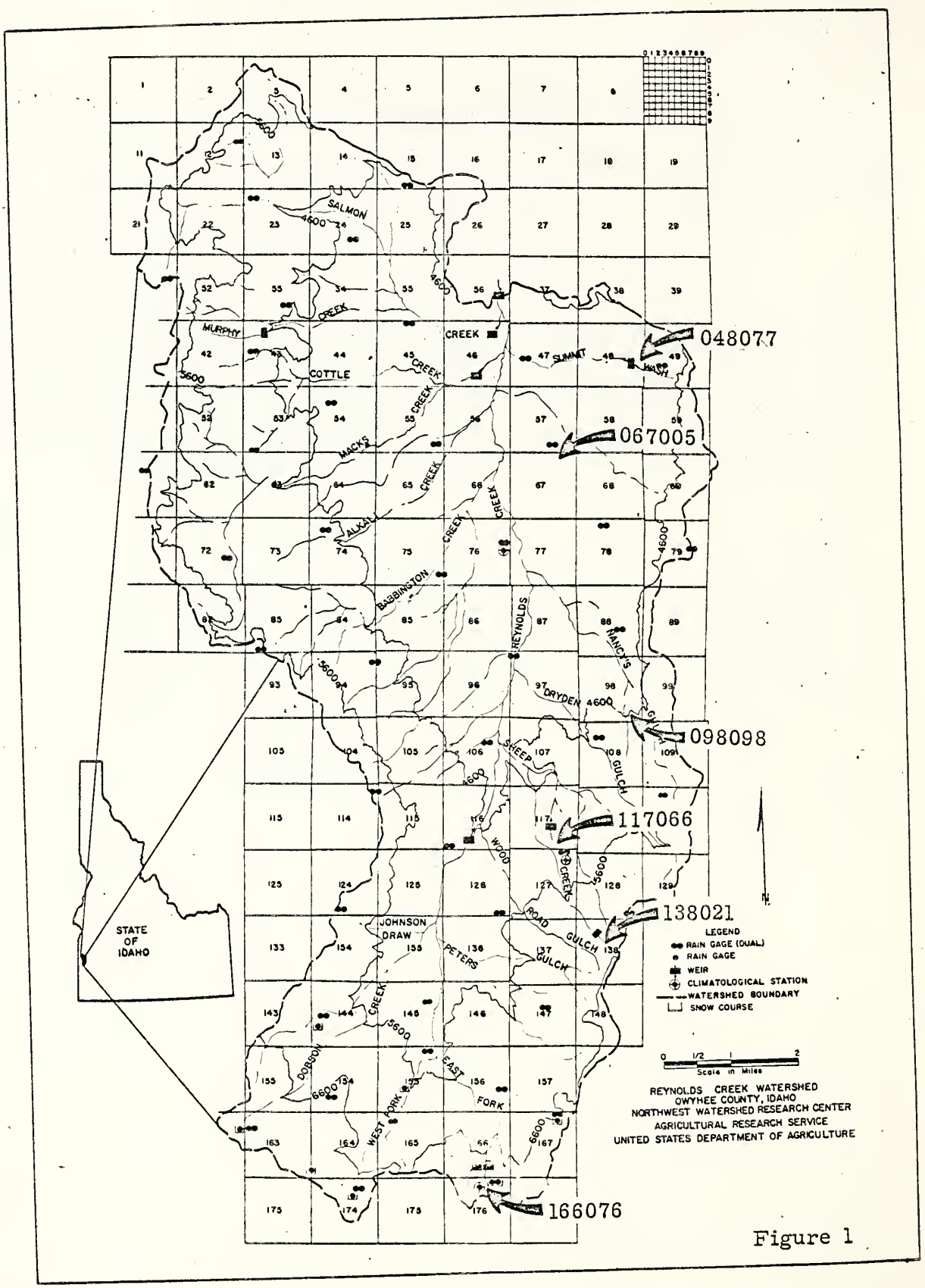
Extensive field data for the determination of the energy budget over sagebrush rangelands has been obtained as a cooperative study with the University of Idaho. Instrumentation used to obtain the field data is shown in Figure 13.

Progress toward the development of an evapotranspiration model for rangelands is reported in the Annual Reports for 1968 and 1969 (Appendices I and II) under Research Outline 106.1.

Sediment Yield

Instrumentation for the measurement of sediment yield is in operation at Site 166076 on the Reynolds Mountain East Watershed, Figures 1, 15, and 16. Sediment collection boxes for bedload have been constructed as part of the weir installations on the Upper Sheep Creek Watershed, Figures 8 and 9. Suspended sediment samplers will be installed at these and other sites during 1970.

Total sediment yields for a number of small watersheds were obtained during August 1968 following the occurrence of excessive rainfall. A typical sediment deposit is shown in Figure 17. Information on the sediment produced by this storm and summaries of progress on studies concerned with sediment-runoff relationships for rangeland watersheds are found in the Annual Reports for 1968 and 1969 (Appendices I and II) under Research Outline 107.1.


048077
067005
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STATE OF IDAHO
SALMON
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ALKALI
BABBINSTON
REYNOLDS
DRYDEN
SHEEP
WOOD
JOHNSON DRAW
PETERS
DOBSON
EAST FORK
WEST FORK
LEGEND
RAIN GAGE (DUAL)
RAIN GAGE
WEIR
CLIMATOLOGICAL STATION
WATERSHED BOUNDARY
SNOW COURSE
Scale in Miles
REYNOLDS CREEK WATERSHED
OWYHEE COUNTY, IDAHO
NORTHWEST WATERSHED RESEARCH CENTER
AGRICULTURAL RESEARCH SERVICE
UNITED STATES DEPARTMENT OF AGRICULTURE

Figure 1

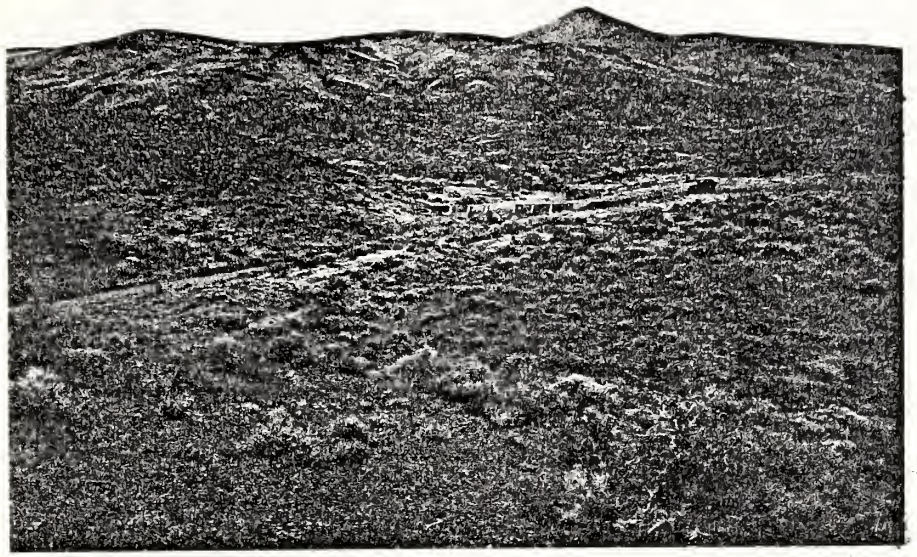

Figure 2. View of Summit Basin and Weir, Site 048077.

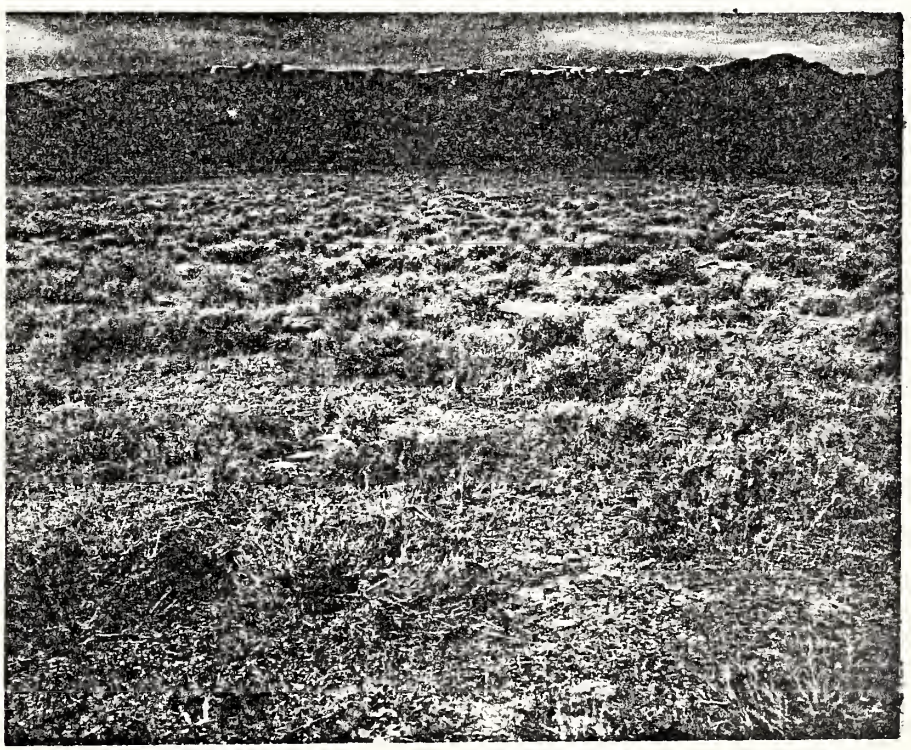

Figure 3. Study Site on Sediments, Site 067005.

Figure 4. Study Site on Nancy's Draw, Site 098098.

Figure 5. Lower Sheep Creek Study Basin, Site 117066.

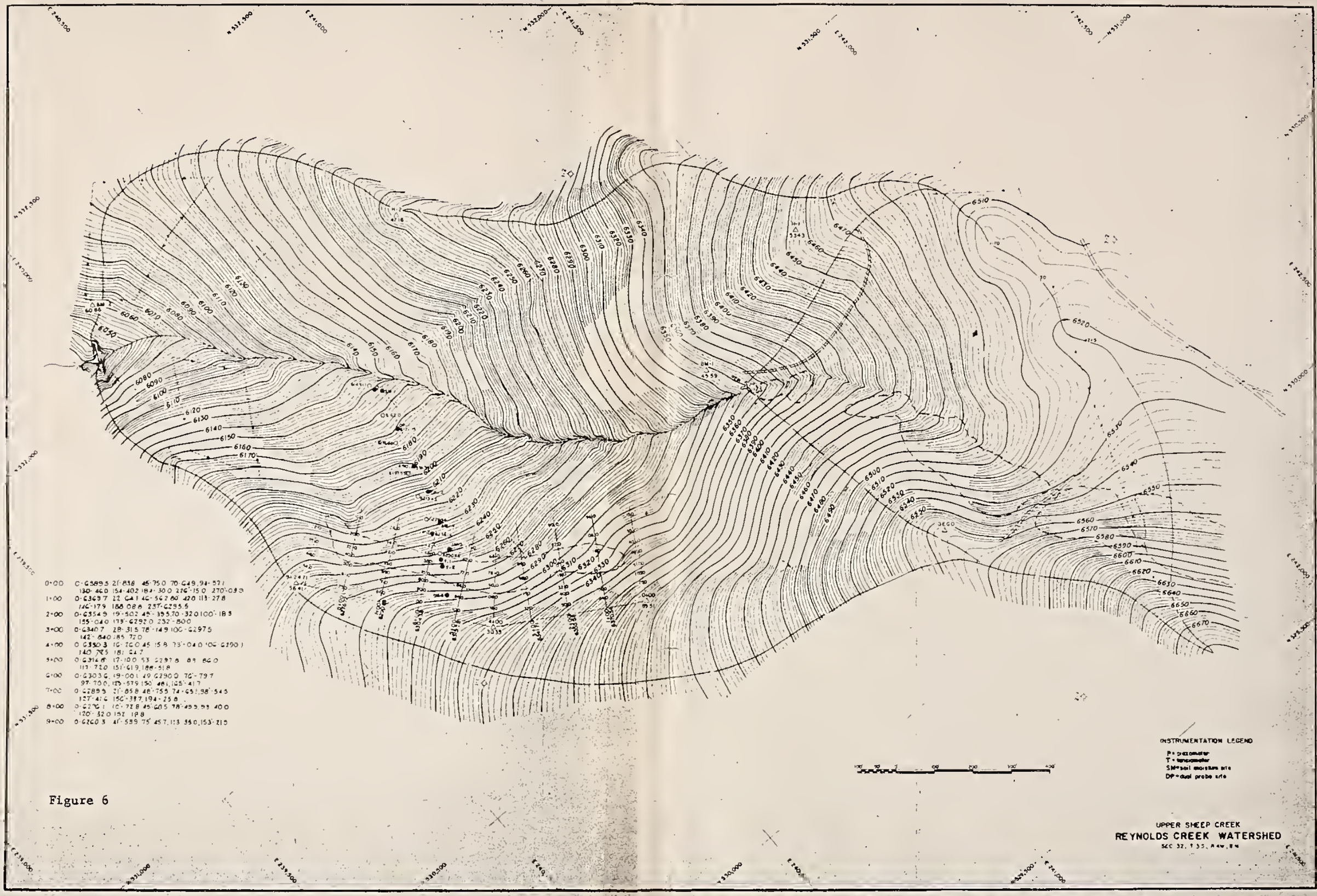
INSTRUMENTATION LEGEND
P = piezometer
T = thermometer
SM = soil moisture site
DP = dual probe site
UPPER SHEEP CREEK
REYNOLDS CREEK WATERSHED
SEC 32, T 3S., R 4W., BM

Figure 6

Figure 7. Upper Sheep Creek Study Basin, Site 138021 (Lower Weir).

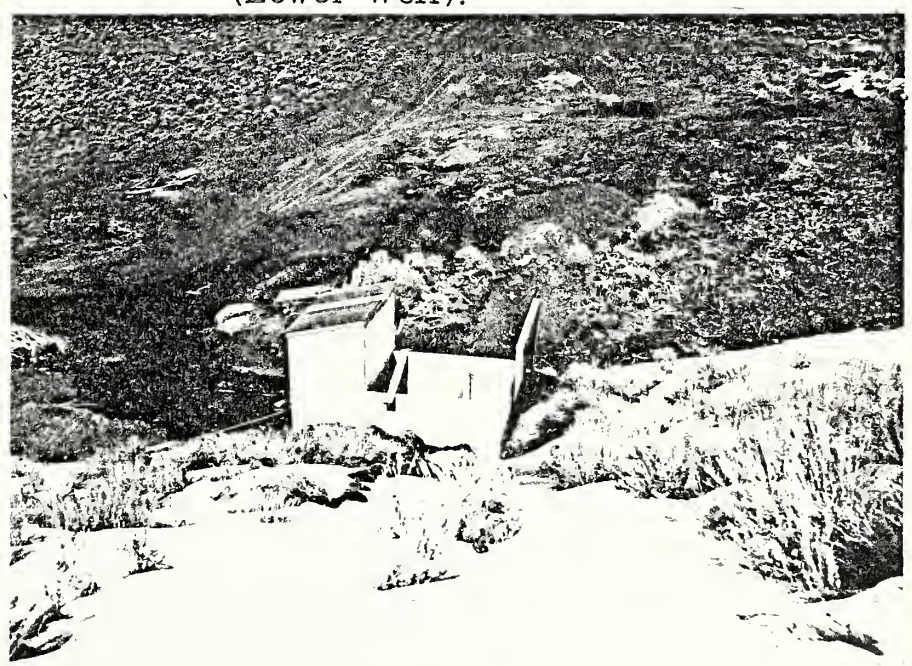

Figure 8. Runoff and Sediment Measuring Station, Lower Site, Upper Sheep Creek Basin.

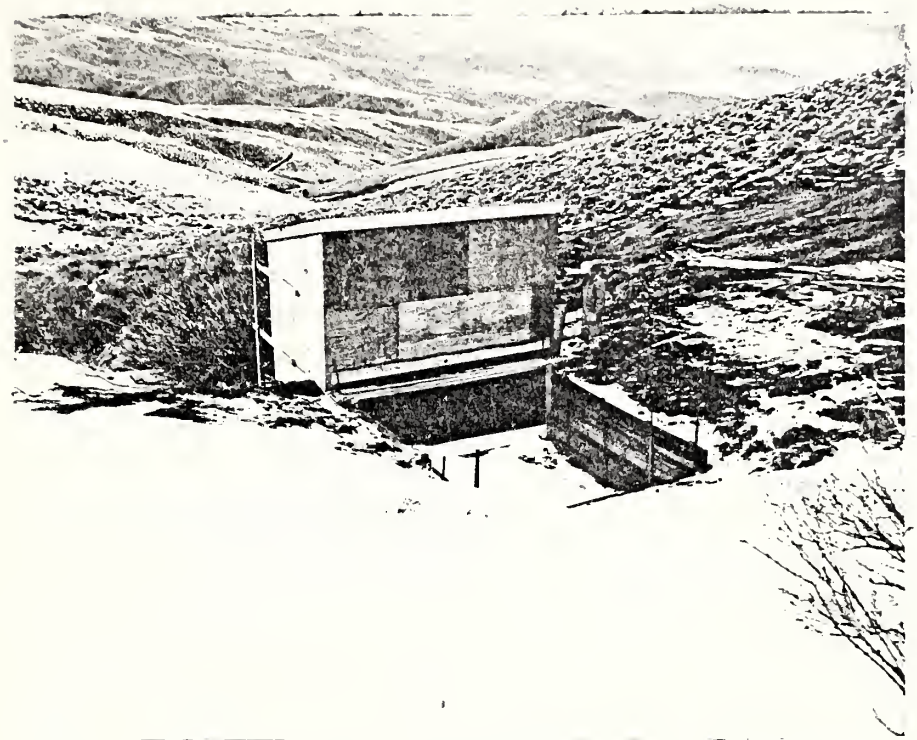

Figure 9. Runoff and Sediment-Measuring Station, Upper Site, Upper Sheep Creek Basin.

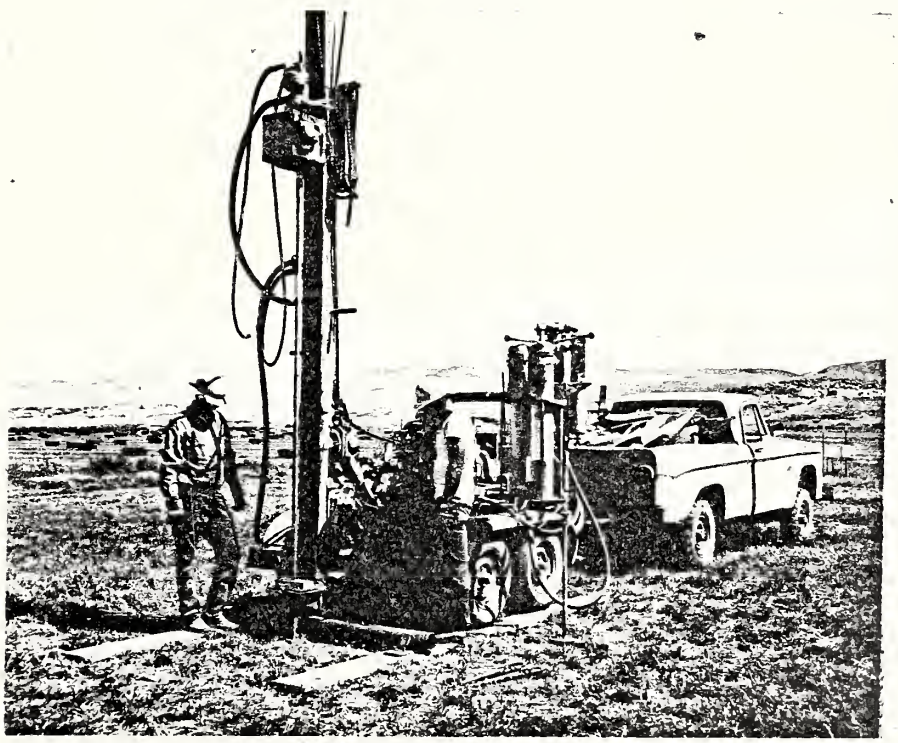

Figure 10. Installation of Soil Moisture Access Tube.

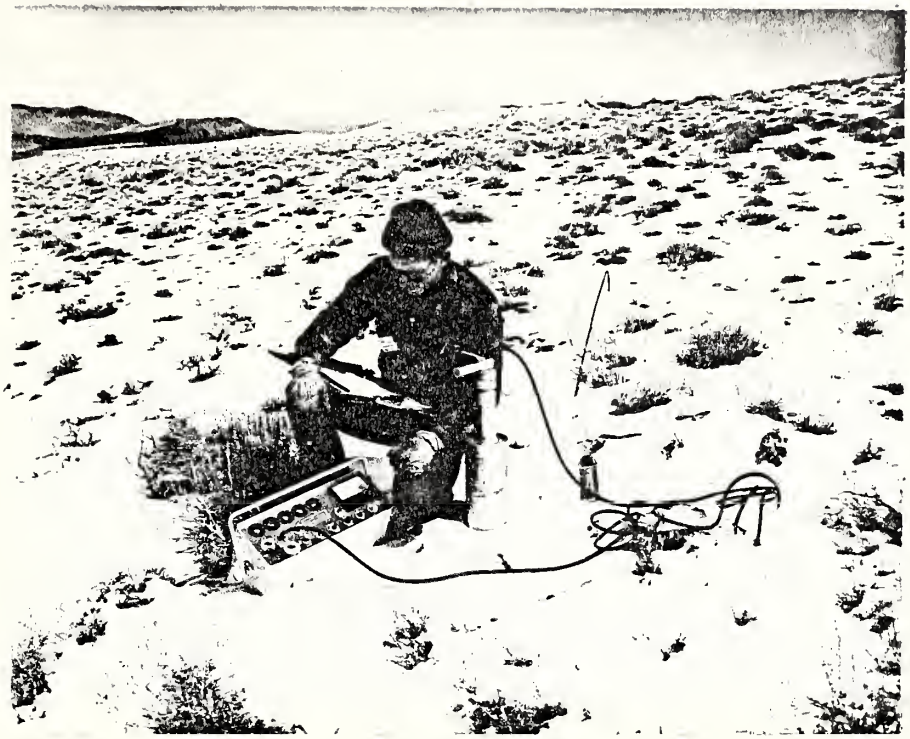

Figure 11. Measurement of Soil Moisture with the Neutron Probe.

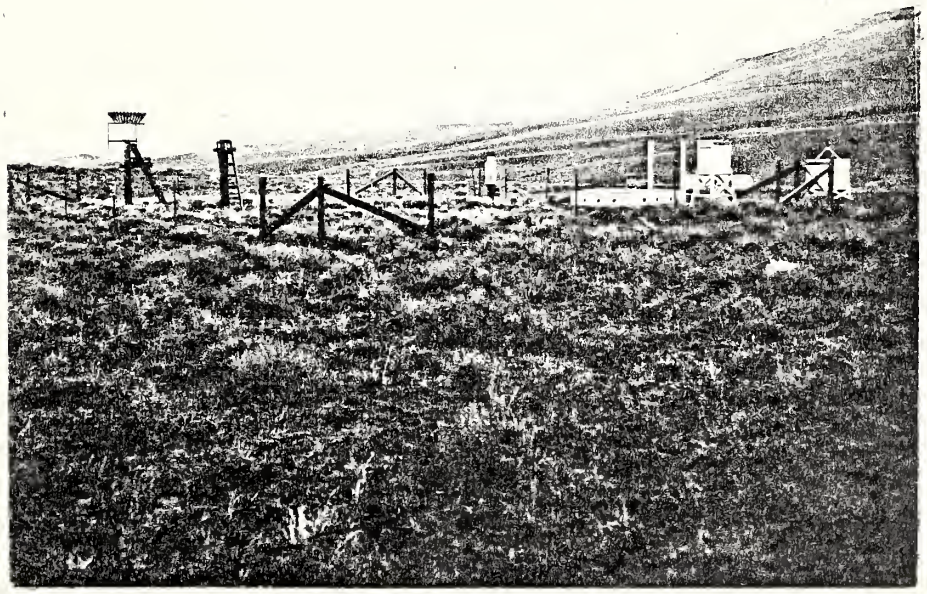

Figure 12. Lysimeter and Climatological Station, Sheep Creek Site 127007.

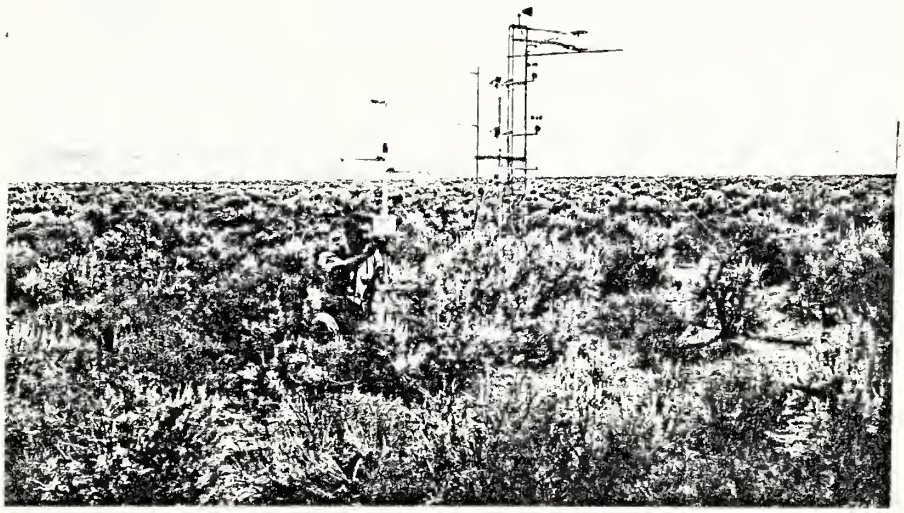

Figure 13. Micrometeorological Measurements for Energy Budget Determinations, Alkali Flats 065009.

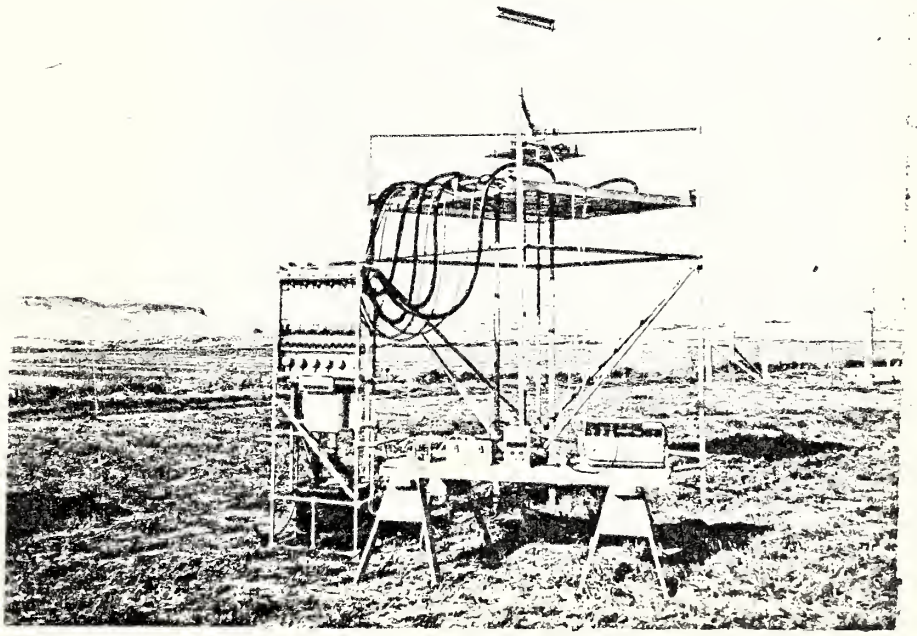

Figure 14. Gamma Probe-Rainfall Simulator Infiltrometer.

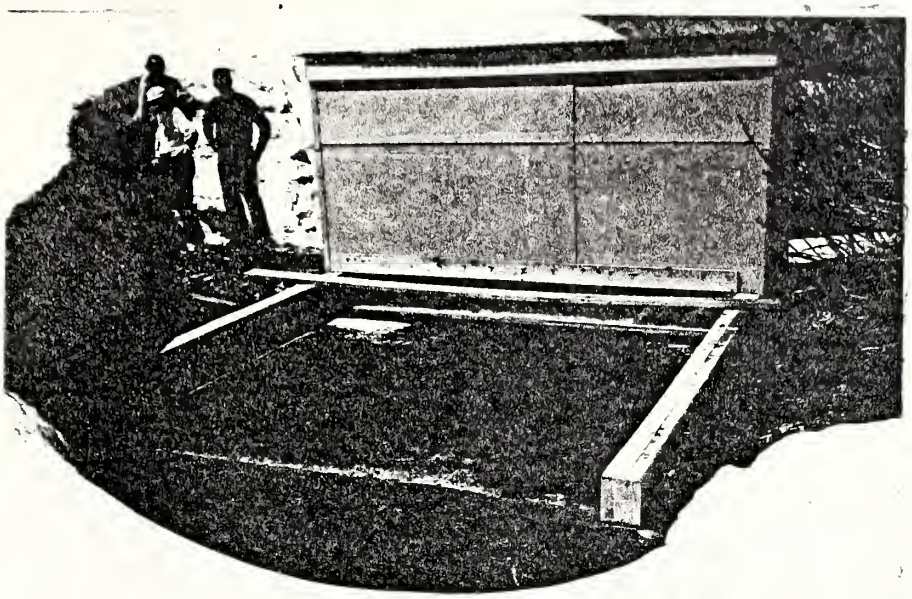

Figure 15. Sediment and Runoff Measuring Station, Reynolds Mountain East Basin, 166076.

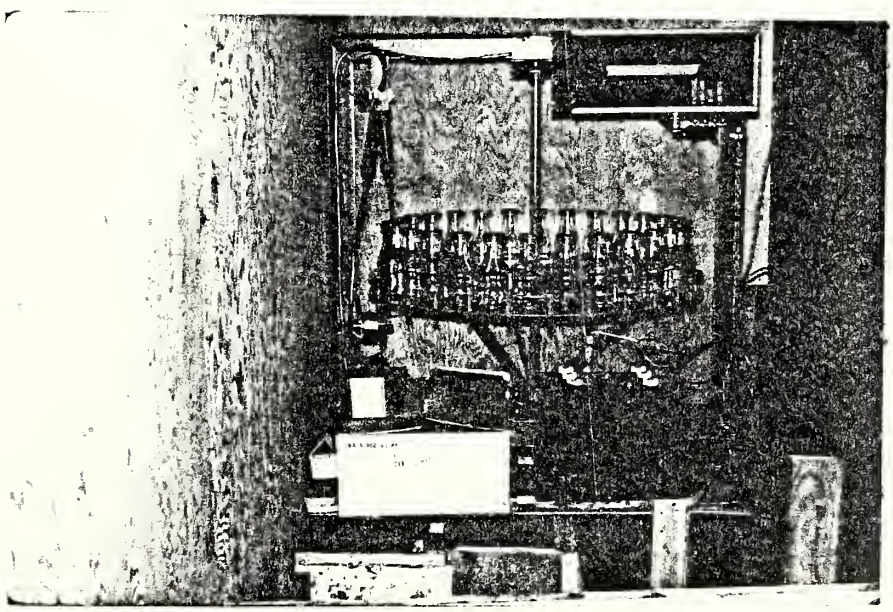

Figure 16. Chickasha Suspended Sediment Pumping Sampler, Reynolds Mountain East Basin, 166076.

Figure 17. Sediment Yield from the Thunderstorm Event of August 14, 1968.